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Original Article / Özgün Araştırma

Evaluation of the Relationship between Psoas: lumbar Vertebral Index and Serum Inflammatory Markers in Elderly Patients

Mustafa Kara [1], **Serkan Bayram** [2]

1 Department of Orthopedics and Traumatology, Siverek State Hospital, Şanlıurfa, Turkey

2 Istanbul University, Istanbul Faculty of Medicine, Department of Orthopaedics and Traumatology, Istanbul, Turkey

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Abstract

Aims: We investigated the relationship between novel inflammatory parameters and Psoas:lumbar vertebra index (PLVI) in elderly patients and assessed which parameter would have a stronger relationship with sarcopenia.

Method: We retrospectively evaluated the prospective recorded data of patients aged over 65 who were admitted to our hospital between June 2019 and September 2020. We used the PLVI calculated using the cross-sectional area of the L4 vertebral body and the left and right psoas muscles by using computer tomography, to assess central sarcopenia. Laboratory tests were evaluated, which consisted of white blood cell (WBC), albumin, neutrophils, lymphocytes, hemoglobin, C-reactive protein, platelets, Neutrophil to lymphocyte ratio (NLR), and platelet to lymphocyte ratio (PLR).

Results: Six hundred and eleven patients (351 females and 260 males) with a mean age (and standard deviation) of 73.7 ± 6.8years were included in this study. Statistically significant relationships were found between age and PLVI. Patient age was also significant correlated with albumin, platelets, lymphocytes, hemoglobin, and NLR. Statistically significant relationships were found between gender and PLVI. Gender was also significant correlated with albumin, platelets, lymphocytes, hemoglobin, and NLR. Psoas:lumbar vertebral index was significantly correlated with platelets and hemoglobin.

Conclusion: According to our results, the inflammatory panel, which included NLR, PLR, CRP, and WBC, were not significantly associated with low PLVI in elderly Turkish people. Central sarcopenia was detected especially in elderly and female participants. Although the inflammatory markers were not associated with sarcopenia, platelet and hemoglobin levels were observed to be significantly correlated with sarcopenia.

Keywords: elderly patients; neutrophil to lymphocyte ratio; platelet to lymphocyte ratio; Psoas:lumbar vertebral index; sarcopenia

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Correspondence / Yazışma Adresi: *Serkan Bayram, Department of Orthopedics and Traumatology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, 34093, Turkey e-mail: dr.serkanbayram89@gmail.com*

Psoas: lumbar Vertebral İndeks ile Serum İnflamatuar Belirteçler Arasındaki İlişkinin Yaşlı Hastalarda Değerlendirilmesi

Öz

Amaç: Yaşlı hastalarda yeni inflamatuar parametreler ile Psoas:lombervertebra indeksi (PLVI) arasındaki ilişkiyi araştırdık ve hangi parametrenin sarkopeni ile daha güçlü bir ilişkisi olacağını değerlendirdik.

Yöntemler: Haziran 2019-Eylül 2020 tarihleri arasında hastanemize başvuran 65 yaş üstü hastaların prospektif kayıtlı verilerini geriye dönük olarak değerlendirdik. Santral sarkopeniyi değerlendirmek için bilgisayarlı tomografi kullanılarak L4 vertebra gövdesi ve sol ve sağ psoas kaslarının kesit alanı kullanılarak hesaplanan PLVI'yi kullandık. Beyaz kan hücresi (WBC), albümin, nötrofiller, lenfositler, hemoglobin, C-reaktif protein, trombositler, Nötrofil / lenfosit oranı (NLR) ve trombosit / lenfosit oranından (PLR) oluşan laboratuvar testleri değerlendirildi.

Bulgular: Ortalama yaşı (ve standart sapması) 73,7 ± 6,8 yıl olan altı yüz on bir hasta (351 kadın ve 260 erkek) bu çalışmaya dahil edildi. Yaş ve PLVI arasında istatistiksel olarak anlamlı korelasyon saptandı. Hasta yaşı ayrıca albümin, trombosit, lenfosit, hemoglobin ve NLR ile de anlamlı derecede korele olduğu saptandı. Cinsiyet ve PLVI arasında istatistiksel olarak anlamlı korelasyon saptandı. Cinsiyet ayrıca albümin, trombosit, lenfosit, hemoglobin ve NLR ile de anlamlı olarak korele olduğu saptandı. Psoas:lombervertebral indeks, trombosit ve hemoglobin ile önemli ölçüde korele olduğu saptandı.

Sonuç: Sonuçlarımıza göre, yaşlı Türklerde NLR, PLR, CRP ve WBC'yi içeren inflamatuar panel, PLVI ile anlamlı olarak ilişkili değildi. Özellikle yaşlı ve kadın katılımcılarda santral sarkopeni saptandı. Enflamatuar belirteçler sarkopeni ile ilişkili olmasa da trombosit ve hemoglobin düzeylerinin sarkopeni ile anlamlı düzeyde ilişkili olduğu gözlendi.

Anahtar kelimeler: yaşlı hastalar; nötrofil/lenfosit oranı; trombosit/lenfosit oranı; Psoas: lombervertebra indeksi; sarkopeni.

INTRODUCTION

Progressive loss of body muscle mass and muscle strength capacity especially in elderly patients are one of the major health concerns for themselves and their caregivers. Sarcopenia is a highly common morbidity ranging up to between 40% and 50% of individuals that are 80 years and older and is recently designited by the European Working Group on Sarcopenia in Older People[1,2]. Elevations of circulating proinflammatory mediators in the elderly population have also been reported to consequence of a chronic low-grade inflammatory period[3]. This process has also been reported to be related to lower muscle mass and muscle strength. Aging-related chronic low-grade inflammatory processes may be a result of increased blood levels of inflammatory mediators, such as erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP)[4,5] . Additionally, albumin level has been reported to have a relationship with the development of low muscle strength or muscle mass[6].

The recently used inflammatory markers including Neutrophil to lymphocyte ratio (NLR), and platelet to lymphocyte ratio (PLR) have utilized as possible indirect inflammatory markers for the evaluation of acute or chronic processes of inflammation[7,8]. Neutrophil to lymphocyte ratio and PLR levels and their relationship with the inflammatory mediators in patients with sarcopenia in the elderly population has been previously investigated[9].

In that study, we researched the correlation between these latest inflammatory mediators and Psoas:lumbar vertebra index in elderly patients and assessed which parameter would have a stronger relationship with sarcopenia.

METHOD

We researched the recorded data of patients aged over 65 who were admitted to our hospital between June 2019 and September 2020 retrospectively. The consent was obtained from these patients to use their data and the IRB (institutional review board) approval was procured for this study (20.06.2022, HRU22.12.21 Harran University Clinical Research Committee).

Age greater than 65 years and admitted to our emergency or our outpatient department, patient with low-grade injury (such as simple fall) or non-traumatic complaint, and availability of computer tomography (CT) scans (show the L4 level and within one month) included this study.

Patients with clinical evidence of acute or chronic inflammation, terminal stage disease, chronic liver and kidney diseases, malignancy, high-grade trauma, history of lumbar spine, patients with abnormal laboratory results (in this study we especially excluded according to the white blood cell (WBC) count which WBC counts >11.0 (×103 cells/mm3) and <4.0 (×103 cells/mm3), with missing data, and acute infection disease were excluded. A total 611 patients were included this study.

Laboratory Sampling

Blood were obtained from the antecubital vein from all patients and were investigated in the same laboratory. Laboratory tests were evaluated, which consisted of WBC (4.5–11 103/L), albumin (3.2–5.5 g/dL), neutrophils 2.8–10.0 103/L, lymphocytes (1.2–3.6 103/L), hemoglobin (13.6–17.2 g/dL), CRP (0–5 mg/dL), and platelets (155–375 103/L). NLR and PLR were calculated as the absolute platelet counts and neutrophil counts divided by the absolute lymphocyte counts, respectively.

Evaluation of Psoas: lumbar Vertebra Index

Digital analyses of CT measurements were done using a digital software (FONET PACS, Ankara). To evaluate the Psoas:lumbar vertebral index for loss of skeletal muscle mass and sarcopenia, which is a measure that has been previously established in a similar studies, all measurements were done one time by two authors (M.K and S.B) independently to decrease interobserver errors, which found inter- class correlation coefficients = 0,990, 95% confidence interval [CI] = 0.897–0.993). (10) On the axial cut of each patient's CT scan at the superior endplate of the L4 vertebral body, the area of the right and left psoas muscle at this level was calculated, and the area of the L4 vertebral body at this level was measured to formulate the Psoas:lumbar vertebra index.

Statistical Analyses

All statistical analyses were performed using SPSS (Statistical Package for the Social Sciences) version 22.0 (IBM Corp, 2011, Armonk, New York). Descriptive statistical methods were used to evaluate the study data. Normality of distribution was evaluated using the Shapiro-Wilk test. Pearson correlation analysis was used to identify relationships between the variables with normal distribution, while Spearman correlation was used for those variables that did not exhibit normal distribution. Patients were initially stratified into high versus low Psoas:lumbar vertebral index groups with a median value of 0.669 to identify the baseline characteristic differences[10], and patients were also divided into two groups according to the median age, which was at 72 years. Student's t-test was used for a comparison of the two (according to age, gender, and PLVI) groups. A p value less than 0.05 was considered to be statistically significant.

RESULTS

Six hundred and eleven patients (351 females and 260 males) with a mean age (and standard deviation) of 73.7 ± 6.8years (range: 65 to 103 years) were included in this study. Baseline demographic, laboratory, and PLVI parameters are demonstrated in Table-1.

Table I: Baseline Characteristics in all Patients

N: 611	*Mean ± SD*	*Min-Max*
Age, year	73,7 ± 6,8	65 - 103
Female/Male	351/260	
Psoas:lumbar vertebral index	0,684 ± 0,19	0,27 - 1,34
Albumin, g/dL	3,64 ± 0,3	2,2 - 5,30
White blood cell, 10^3/L	8,43 ± 1,72	4,5 - 11
Hemoglobin, g/dL	13,5 ± 1,9	9,9 – 17,1
C-reactive protein, mg/dL	4,2 ± 3,2	0-26
Neutrophil, 10^3/L	5,6 ± 2,01	1,42- 10,8
Lymphocyte, 10^3/L	2,2 ± 1,1	0,2 – 8,6
Platelet, 10^3/L	251,2 ± 75	55-600
Neutrophil to lymphocyte ratio	3,34 ± 3	0,4 – 40
Platelet to lymphocyte ratio	135,7 ± 72	14-1056

SD: Standard deviation; Min: Minimum; Max: Maximum; mg: milligram; g: gram

Baseline Characteristic Differences for Age

Patients were initially stratified into younger versus elderly patient groups with a median age of 72 years in order to identify baseline characteristic differences. A total of 256 patients (130 females and 126 males) with a median age of <72 years were allocated into the younger group, and 355 (221 females and 134 males) patients with a median age of ≥72 years were defined as the elderly group. In the patient demographic, laboratory, and PLVI results differences between the younger and elderly patient groups, significant differences were observed in age, gender, albumin, hemoglobin, and PVLI (Table-2). No statistically significant differences in WBC, CRP, neutrophil, lymphocyte, NLR, and PLR between the two groups were observed.

Table II: Baseline characteristic differences between younger and elder patients

	Patients with younger than 72 years (n: 256)		Patients with elder than 72 years (n: 355)		
	Mean ± SD	Min-Max	Mean ± SD	Min-Max	p value
Age, years	67,97 ± 2,1	65-72	78,1 ± 6,2	72-103	<0,001**
Female/Male	130/126		221/134		0,005**
Psoas:lumbar vertebral index	0,710±0,19	0,29 –1,34	0,664± 0,18	0,27 – 1,28	0,001**
Albumin, g/dL	3,72 ± 0,36	2,8 – 5,3	3,57 ± 0,38	2,2 – 4,6	<0,001**
White blood cell, 10^3/L	8,79 ± 1,9	4,5 – 11	8,46 ± 1,79	4,5 – 10,8	0,173
Hemoglobin, g/dL	14,06 ± 1,8	*9,9 – 17,1	13,24 ± 1,6	11-17	<0,001**
C-reactive protein, g/dL	5,07 ± 4,6	0-24	4,57 ± 4,9	1-26	0,345
Neutrophil, 10^3/L	5,9 ± 2,1	2,1 – 10,8	5,53 ± 1,8	1,4 – 9,7	0,147
Lymphocyte, 10^3/L	2,33 ± 1,1	0,4 – 8,6	2,23 ± 1,1	0,2 – 8	0,229
Platelet, 10^3/L	253,2 ± 71	70 –570	246,2 ± 83	55 – 600	0,197
Neutrophil to lymphocyte ratio	3,5 ± 3,4	0,65 - 29	3,44 ± 3,7	0,4- 40	0,751
Platelet to lymphocyte ratio	131 ± 76	26-660	139,1 ± 99	14 - 1056	0,264

SD: Standard deviation; Min: Minimum; Max: Maximum;

Baseline Characteristic Differences for Gender

Patients were initially stratified by sex in order to identify baseline characteristic differences. A total of 351 females with a mean age of 74.69 ± 7.4 years, and 260 males with a mean age of 73.5 ± 6.6 years were included (p = 0.056). Of the patient demographic, laboratory, and PLVI results between the females and males, significant differences were observed in lymphocyte, platelet, NLR, hemoglobin, and PLVI (Table-3). There was no statistically significant difference in age, albumin, WBC, CRP, neutrophil, and PLR between the groups.

Table III: Baseline characteristic differences between women and men

	Women (n: 351)		Men (n:260)		
	Mean ± SD	Min-Max	Mean ± SD	Min-Max	p value
Age, years	74,69 ± 7,4	65-103	73,5 ± 6,6	65-92	0,556
Psoas:lumbar vertebral index	0,599±0,15	0,27 – 1,28	0,799±0,17	0,40– 1,34	0,004*
Albumin, g/dL	3,66 ± 0,3	2,4 – 4,6	3,59 ± 0,41	2,2 – 5,3	0,54
White blood cell, 10^3/L	8,65 ± 1,8	4,7 – 11	8,51 ± 1,81	4,5 – 11	0,868
Hemoglobin, g/dL	13,14 ± 1,2	10,1 – 17,1	14,13 ± 2	11,8-17	0,001*
C-reactive protein, g/dL	5,08 ± 4,2	0-22	4,33 ± 4,3	0-26	0,081
Neutrophil, 10^3/L	5,68 ± 2	1,4 – 10,8	5,76 ± 2,1	2,1 – 10,6	0,241
Lymphocyte, 10^3/L	2,37 ± 1	0,2 – 8,5	2,14 ± 1,2	0,3 – 8,6	0,011*
Platelet, 10^3/L	262,6± 75	55 – 590	231,2 ± 76	60 – 600	<0,001*
Neutrophil to lymphocyte ratio	3,11 ± 3,4	0,45 – 47,8	3,95 ± 3,8	0,53- 29,6	0,002*
Platelet to lymphocyte ratio	132,4 ± 82	15-1056	142 ± 95	14-1044	0,195

SD: Standard deviation; Min: Minimum; Max: Maximum;

Baseline Characteristic Differences for High vs. Low Psoas:lumbar Vertebral Index

Psoas:lumbar vertebral index measurements ranged from 0.27 to 1.34 with a mean of 0.684 ± 0.19 and a median of 0.669. Patients were initially stratified into low and high PLVI patient groups with a median value 0.669 to identify baseline characteristic differences. A total of 308 patients (247 women and 61 men) with a median value of <0.669 were allotted to the low PLVI group, and 303 (104 women and 199 men) patients with a median value of ≥0.669 were allotted to the high PLVI group. Of the patient demographic and laboratory results differences between the low versus high PLVI, significant differences were observed in age, gender, hemoglobin, and platelets (Table-4). No statistically significant difference in albumin, WBC, CRP, neutrophil, lymphocyte, NLR, and PLR between the groups was observed.

Table IV: Baseline characteristic differences for high vs. low psoas lumbar vertebral index

	Patients with low PLVI (n: 308)		Patients with high PVLI (n: 303)		
	Mean ± SD	Min-Max	Mean ± SD	Min-Max	p value
Age, years	74,6 ± 7,3	65-99	72,7 ± 6,1	65-103	<0,001**
Female/Male	247/61		104/199		<0,001**
Psoas:lumbar vertebral index	0,524±0,09	0,27-0,67	0,839±0,13	0,67-1,34	<0,001**
Albumin, g/dL	3,64 ± 0,39	2,4 – 4,9	3,62 ± 0,38	2,2 – 5,3	0,726
White blood cell, 10^3/L	8,53 ± 1,7	4,8 – 11	8,60 ± 1,83	4,5 – 11	0,461
Hemoglobin, g/dL	13,1 ± 1,6	10 – 17,1	14,05 ± 2	9,9-16,9	<0,001**
C-reactive protein, g/dL	5,07 ± 4,8	0-23	4,58 ± 4,9	0-26	0,192
Neutrophil, 10^3/L	5,66 ± 2	1,4 – 10,8	5,76 ± 2,1	2,1 – 10,6	0,387
Lymphocyte, 10^3/L	2,31 ± 1,2	0,2 – 8,6	2,24 ± 1	0,3 – 8,2	0,750
Platelet, 10^3/L	255,1 ± 73	60 – 550	242,6 ± 70	86 – 600	0,040*
Neutrophil to lymphocyte ratio	3,36 ± 3,7	0,4 - 40	3,57 ± 3,4	0,5- 29	0,518
Platelet to lymphocyte ratio	136 ± 92	16-1010	135 ± 96	14-1056	0,787

SD: Standard deviation; Min: Minimum; Max: Maximum

Statistically significant relationships were found between age and PLVI (p= 0.001 r= −0,116). Patient age was also significant correlated with albumin, platelets, lymphocytes, hemoglobin, and NLR (p< 0.011 r=−0.214; p=0.006 r:−0.111; p=0.006 r=−0.110; p< 0.001 r=−0.194; and p=0.027 r=0.089, respectively). Statistically significant relationships were found between gender and PLVI (p< 0.001 r=0.524). Gender was also significant correlated with albumin, platelets, lymphocytes, hemoglobin, and NLR (p=0.035 r=−0.091; p< 0.001 r=−0.248; p< 0.001 r=−0.156; p< 0.001 r=0.312; and p< 0.001 r=0.144, respectively). Psoas:lumbar vertebral index was significantly correlated with platelets and hemoglobin (p=0.002 r=−0.125 and p< 0.001 r=0.296, respectively), (Figure 1 and 2).

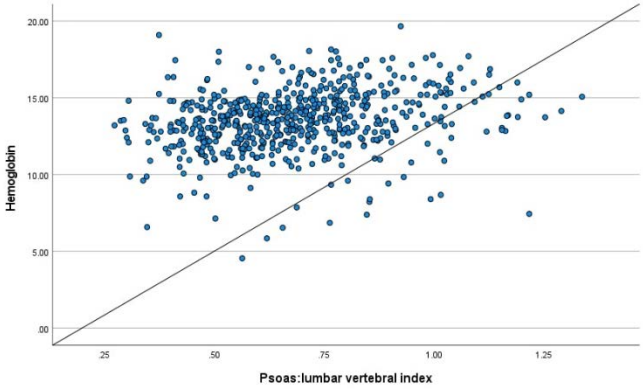

Figure 1. Scatterplot showing the correlation between the Psoas: lumbar vertebra index and albumin.

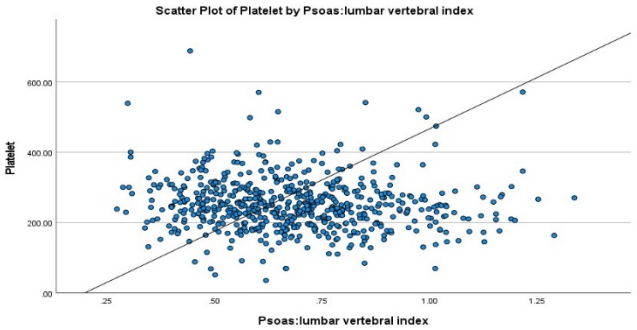

Figure 2. Scatterplot showing the correlation between the Psoas: lumbar vertebra index and platelet.

DISCUSSION

Because of the functional declining relationship with sarcopenia can in turn contribute to a number of adverse health outcomes, including loss of disability, function, and frailty, sarcopenia is seen as a major issue nowadays especially in elder patients[11,12]. In this study, we found that sarcopenia significantly correlated with age, sex, platelets, and hemoglobin. However, the NLR, PLR, and CRP were not observed to be associated with sarcopenia.

Advanced age is a known risk factor for sarcopenia, which is accounted for by the physiology of aging or an inherent decline in various organ systems, and includes increased levels of inflammatory markers (CRP, IL-6), diminution in bone density (osteoporosis), cognitive changes (delirium and dementia), and sarcopenia[13]. Sarcopenia is an age-related process, and is related to a marked loss of muscle mass and strength occurring around age 50[14]. Cho et al reported on a study that included 8,092 participants aged <50 years for the young group and 8,221 participants aged >50 years for the older group[15]. In that study, they found that the prevalence of sarcopenia was 9% (732) in the young group and 21.5% (1,767) in the older group. Another study by Lee et al. evaluated the prevalence of sarcopenia in healthy, elderly, female Koreans, which included 196 ambulatory females over the age of 65 years[16]. In that study, they found that 15 of 196 females (7.6%) were eligible to be classified into the sarcopenia stage. In our study, 303 of 611 participants (49.5%) were allocated to the high PLVI group. There was a significant difference between low and high PLVI index group regarding age ($p < 0.001$). The mean age in the low PLVI group was 74.6 ± 7.3 and high PLVI 72.7 ± 6.1. Statistically significant relationships were found between age and PLVI ($p=0.001$ $r=-0.116$).

Although the relationship between age and sarcopenia has been clearly demonstrated, its relationship with gender is contradicting. Janssen et al. reported on a study that investigated the presence of sarcopenia that included 4,504 adults aged 60 and older[17]. In that study, they found that the prevalence of sarcopenia was greater in the older (> or = 60 years) females than in the older males ($p< 0.001$). In another study, Iannuzzi-Sucich et al. evaluated the prevalence of sarcopenia in a population of older participants that was composed of 195 females aged 64 to 93 years and 142 males aged 64 to 92 years[18]. In that study, the prevalence of sarcopenia was 22.6% in females and 26.8% in males, and subgroup analysis of the females and males 80 years or older revealed prevalence rates of 31.0% and 52.9%, respectively. Kirchengast S et al. also reported gender differences in the prevalence of sarcopenia and documented gender differences in lean soft tissue mass in healthy elderly

patients. This study enrolled 139 healthy subjects aged between 59 and 92 years (x = 71.5 +/- 7.8), composed of 77 females and 64 males[19]. In their study, they found that gender differences in the prevalence of sarcopenia were more significant in people younger than 70 years old and those older than 80 years old. In the youngest age group (<70 years) sarcopenia was found more frequently among female participants, while in the oldest age group (>80 years). In our study, which included 351 females and 260 males, the PLVI was significantly higher in males than in women. The mean PLVI in women was 0.599 ± 0.15 and 0.799 ± 0.17 in men (p=0.004).

The previous studies have clearly demonstrated that inflammatory cytokines activate many of the molecular pathways involved in muscle loss, leading to an imbalance between protein synthesis and catabolism[20]. Many inflammatory markers, such as interleukin-6 and tumor necrosis factor α, have been linked with sarcopenia[21]. Liaw et al. assessed the evaluation between PLR and sarcopenia in a study, which enrolled 3,671 non-institutionalized individuals aged ≥60 years[22]. In their study, they emphasized that higher PLR levels are associated with a greater risk of sarcopenia in geriatric populations and found that participants with the highest serum PLR values (≥155) had 2.36 times greater risk of developing sarcopenia than those with the lowest PLR values (<90). Another study by Tang et al. that reported on a cross-sectional study in China investigating the relationship between sarcopenia and inflammatory markers and included 384 participants showed that 61 participants (15.9%) were diagnosed with sarcopenia according to the AWGS criteria[23]. In that study, the three inflammatory indexes PLR, NLR, and lymphocyte-to-monocyte ratio were not significantly associated with sarcopenia. In our study, we investigated the relationship between sarcopenia and albumin and the blood count, which included WBC, neutrophils, lymphocytes, hemoglobin, platelets, CRP, NLR, and PLR. Although none of the inflammatory markers (NLR, CRP, PLR, and WBC) were significantly associated with PLVI, platelets and hemoglobin were significantly correlated with PLVI (p=0.002 r=−0.125 and p< 0.001 r=0.296, respectively).

This study has several limitations. First, this was a retrospective study, and the sample size was relatively small because it was conducted at a single institution. Second, inflammatory markers such as IL-1, IL-6, TNF-a, and ESR were not evaluated. Last, the calculation of all laboratory results was measured in only a single measurement; therefore, the accuracy of results may be affected by potential laboratory measurement errors and biologic variabilities.

CONCLUSİON

According to our results, the inflammatory panel, which included NLR, PLR, CRP, and WBC, were not significantly associated with low PLVI in elderly Turkish people. Central sarcopenia was detected especially in elderly and female participants. Although the inflammatory markers were not associated with sarcopenia, platelet and hemoglobin levels were observed to be significantly correlated with sarcopenia. Patients with high PLVI have higher hemoglobin levels and lower platelet counts than in patients with low PLVI. Additionally, albumin levels were significantly lower in patients older than 72 years old.

Ethics Committee Approval: The consent was obtained from these patients to use their data and the IRB (institutional review board) approval was procured for this study (20.06.2022, HRU22.12.21 Harran University Clinical Research Committee).

Conflict of Interest: The authors declared no conflicts of interest.

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